

It should also be noted that the present writer's series of 63 shells from one exposure at the type locality, Alton, Ill., shows a much wider range in both diameter and height than given in Baker's description. It very much resembles the recent set from a single colony at Iowa City.

As for the remaining characters, it may be said that the chalky shells of the larger loess species always give the impression of greater solidity, and that the height of the spire and size of the aperture vary equally in both fossil and recent forms. The color bands may also be absent in recent forms and constitute no distinctive character. Thus a set of 114 recent shells from Iowa City shows 81 with bands, 6 with very faint bands and 27 unicolorous.

The table also shows that there is so much overlapping in the several series that no lines can be drawn between different phases. It is, moreover, absurd to apply the name *pleistocenica* to a form which is still living in Iowa and Nebraska, or to infer from it that the climate was much colder during loess deposition.

NOTES ON PHILIPPINE FRESHWATER MOLLUSKS

BY CALVIN GOODRICH

Mr. Pedro de Mesa, of Lubang, made a collection of freshwater shells in three rivers of the Philippine Islands in January of last year. Specimens were taken in such quantities that a satisfactory study of shell variation could be made and a conception be obtained of species distribution. The first lot received was from Agkawayan River of Lubang Island. Mr. de Mesa took the trouble to collect at three different stations of the stream. Unfortunately, the material became mixed during shipment and has had to be considered as a whole. That from the Lilimbon River of Luzon, on the other hand, came through undisturbed, making it clear that while the stream is a short one and everywhere close to the sea, the molluscan fauna at the mouth, midway and near the source is, in each place, fairly distinctive. The Antipode River, a tributary of Pasig River of Luzon, was touched at one spot. The findings on the melanians are here set forth.

Melania setosa Swainson. This species was plentiful near the mouth of Lilimbon River. Three specimens were taken at the

midway station and none at the source. A single shell was in the lot from Agawayan River. The most interesting feature of this mollusk is that the spines at the shoulder develop out of the epidermis and not, as in most spinose freshwater shells, by an extension of the crystalline shell substance. It is true that the bases of these bristles are "bony," but they consist of only blunt projections. They are formed as in spinose *Neritina*, *Murex* and *Io* by an extension of the outer lip which at first is open, then closed on the posterior side and finally strengthened with the aragonite "substratum." This, it may be said in passing, is the manner in which *Elliptio spinosa* (Lea) forms its curious processes. *M. setosa* differs from this simple method in detail. The base has a sloping canal, facing forward. Through this, the periostracum makes its extension. A septum in the shell base forces the follicle upward into a stiff, sharp bristle. The largest of these bristles is 6 mm. from base to tip. The spines when dry are very brittle. Wet, they stand a good deal of rough treatment. Reeve illustrates the species as having irregularly curved or drooping bristles. All I have seen are stiffly upright. *Setosa* is obscurely plicate. Revolving folds or striae cover the shell from shoulder to base. Color is reddish-brown in the young, black in the old. Juveniles have flammules which are confined mostly to the upper parts of the striae.

Brotia asperata (Lamarck). The early post-embryonic whorls are smooth, ornamentation beginning as widely-spaced longitudinal plicae. In 26 of the 109 specimens from the Antipode River, the plicae are set off from the prevailing ground color by a dark pigmentation. Following the axial ribs in growth are incised striae, two to five in number and close to the suture. Later, the spacing between the incised striae becomes the more prominent sculpture, standing out as folds or ridges that on the body whorl cover the whole surface. In six shells, the crossings of plicae and striae are elevated into nodes, being particularly strong at the periphery. Body color ranges from reddish brown to purple or nearly black. The largest shell measures, altitude 65 mm., diameter 24.25 mm. The indicated number of whorls for a full-grown individual is fifteen. Besides the Antipode River, the Lilimbon River contains this species near the source. *Asperata* would appear to be a small-stream form similar to some

species of *Pachychilus*. Another resemblance, that of radula, will be mentioned later.

Melanoides crenulata (Deshayes). Only very young shells show the longitudinal plicae. The distinctive sculpture is striate. The striae of typical specimens that are from near the mouth of Lilimbon River are strong and coarse. They cover the entire body whorl, breaking into one to four rows of beads and rectangles just below the suture. In the largest specimens, this nodulous sculpture is not carried to the body whorl. It is, apparently, a phenomenon of middle-age. Shells taken at the midway station of Lilimbon River are much smoother than those near the stream mouth. Striae are so reduced that they are microscopic in some instances. This species, like most of the Philippine melanians, is marked by delicate flammules, usually irregular in shape. They disappear with age. The largest shell taken by Mr. de Mesa has been reduced to three whorls by erosion. It measures 46.25 mm. altitude, 16.25 mm. diameter. Two small, finely striate specimens occurred in the sending from Agawayan River.

Melanoides aculeus (Lea). This is one of the heavy, elongate, flat-whorled species. It shows small variation, size perhaps excepted, as between colonies. The young are distinctly plicate, a few shells showing incised striae. Longitudinal flammules appear at the top of the early whorls. They disappear as the mollusk, with age, becomes dark-brown or black in color. Specimens run to an altitude of 60 mm. even after considerable loss by erosion. An undamaged specimen would probably have twelve whorls.

Melanoides hastula (Lea). By matching shells of different ages, it is possible to conclude that a full-grown shell of this species has attained to eighteen whorls and that, if uneroded, it would have a length of 120 mm. The young are very attenuate, fragile, angled bluntly at the periphery and ornamented with low plicae between which flammules are deposited. Plicae are not always present, but incised striae appear on the upper whorls and the base is always more or less striate. Ridges, shoulders and nodes occur occasionally at the upper suture. The aperture is elongate-ovate, not much produced. The outer lip is a little sinuate. A characteristic of the species is an increase of the convexity of the whorls with age, an effect of loose-coiling. The largest specimens

seen occur near the mouth of Lilimbon River. There is a reduction in size in the direction of up-stream and some slight accompanying modification of sculpture. About 600 specimens were taken in the Agawayan River, all of them much smaller than those of the Lilimbon. *Melania subula* Lea is probably a synonym.

Melanoides lateritia (Lea.) Dr. Vander Schalie, while preparing radulae of this species, found it to be viviparous. Four shells yielded 147 young. They were of different ages, ranging from $1\frac{1}{2}$ whorls, seemingly the full development of the embryo, to five or six whorls. The shells are deeply sutured with a corresponding convexity of whorls. Ornamentation begins at about the third whorl. This, in most cases, is a keeling of the periphery that develops into striae. Plicae are strong only on the oldest of the juveniles. Half grown shells of *lateritia* display flammules. In addition, certain individuals have one to three bluish or purple bands, and through excess of pigment one shell is bluish over the entire disk. Plicae of adults are broken into regularly spaced squares or rectangles. In instances, these granules are joined into irregular nodes that are a little raised in their centers. The species runs to ten or twelve whorls. Many specimens were taken in the Agawayan River, 28 near the mouth of Lilimbon River, two at the midway station and one near the source. *Melania scropulus* Reeve and *M. obliquegranosa* Smith appear to be synonyms.

Melanoides riquetii Grateloup. Taken only in the Agawayan River. Like *lateritia*, this species is viviparous. Thirty-four young were recovered from three shells. The greatest number were of only three whorls. One specimen had five whorls, two of which were smooth if sharply defined growth lines be excepted. The fourth whorl was plicate over the whole surface, with two striations amounting to keels. Both plicae and striae increased in strength on the fifth whorl. The lip of this specimen was sinuous as in the case of adults. *Riquetii's* outstanding character is the plication which is regularly spaced and follows the sinuous line of the outer lip. Occasional flammules are present.

Melanoides pugilis (Hinds). Taken in numbers near the mouth of Lilimbon River. One specimen appeared in the collection taken midway of the river. The sculpture is stoutly plicate-striate, the plicae developing into "bony" spines at the shoulders.

The reddish color of the shell, broken by flammules of irregular outline, is most conspicuous in the young.

Faunus nitidus von der Busch. Found only in the Agawayan River, but there in numbers. The shells run as large as 50 mm. altitude by 18 mm. diameter, with twelve whorls intact. None had reached the possibly gerontic state in which the fissure at the suture is pronounced and the basal sinus has become conspicuous. Faint traces of plicae appear on some early whorls and are maybe only vestiges of a primitive plication. There is an occasional striation on the neanic whorls near the suture. Color is brownish black in all specimens except a few that are of a mahogany shade. The spires of some of the lighter colored shells show flammules that are more or less prominent.

The operculum of *M. setosa* is thick, black, elongate. The nucleus of all opercula that were seen was worn away as in *Eurymaelon* of the southern United States. *B. asperata*, alone of these melanians, has a paleomelanian operculum. The spirals run to about five whorls. In *M. crenulata*, *aculeus* and *hastula*, the opercula are light reddish-brown in the young, large and black in the old. The surface is crinkled, a marked characteristic of the American *Gyrotoma*. The nucleus is crowded into the left margin near the base, sometimes even resting on the basal margin. The operculum is the form known as subspiral, no doubt a development out of the paucispiral phase. *M. lateritia*, *riquetii* and *pugilis* have small, thin, clavate opercula, the spirals being tightly coiled and reduced to a position near the base. This type of operculum, similar to that of *Pleurocera*, suggests degeneration. For a shell so large, the operculum of *F. nitidus* is rather small. It is ovate, thin, reddish brown. The spiral lines are distinct and of about four whorls. In development, this form of operculum appears to be midway of the paleomelaniid operculum of *asperata* and the neomelaniid form in *aculeus* and *hastula*.

The shape of the plate which bears the cusps of the central teeth is so varied that, on this character alone, almost any of the species may be distinguished from any of the other species. The lateral teeth of *M. setosa*, *M. lateritia*, *riquetii*, *aculeus* and *pugilis* are bent or twisted so that the basal lines of the pedestals lie parallel with the posterior margins of the centrals instead of being, as is usual, oblique or at right angles to them. In shell

characters, *aculeus* and *hastula* have a superficial resemblance, but in this one matter of lateral teeth they are far apart. The marginals, with the exception of those of *asperata*, are very much alike. The inner and outer marginals are difficult to distinguish, their differences consisting in numbers of cusps rather than in their configuration. The radula of *M. setosa* is virtually a duplicate of one taken from a specimen of *M. amarula* L. of Mauritius. The central tooth of *Faunus nitidus* resembles that of *Potamides*, serving as an additional warrant for the erection of the genus. The surprise of this study was the radula of *B. asperata*. It is long, narrow, the teeth strong and well defined. In almost all characters it is identical with the radula of *Doryssa* as illustrated by Dr. H. B. Baker in Occasional Papers, Museum of Zoology, University of Michigan, No. 210, 1930. It appears also to be like the radula of *Potadoma ponthiervillensis* Dupuis and Putzeys, figured by Pilsbry and Bequaert, Bulletin American Museum Natural History, 53, 1927, p. 272.

In an examination of this work, I find that viviparity is known of the melanians *Melanoides tuberculata* (Müller) and *Sulcospira sulcospira* (Mousson) besides the Tanganyika genera *Tiphobia* and *Lavigeria*. It seems likely that the phenomenon is more extensive in the Melaniidae than has generally been thought and that it is a specific as well as a generic adaptation. As for the generic names employed in this paper, the writer has misgivings. *Melanoides* as defined by Pilsbry (1927), "shell never very large or heavy," would rule the Philippine *aculeus* and *hastula* from this genus. *Semisulcospira* as used by Kuroda (Venus, I, 1929) might be available for one form of *crenulata*, but not for the typical mollusk. Characters in the family are extremely plastic. Extensive parallel development has taken place. Bringing the genera into biological unity is a difficulty still to be surmounted.

Following is a list of all the species taken by Mr. de Mesa:

Agkawayan River, Lubang Island

<i>Melania setosa</i> Swainson	" <i>riquetii</i>
<i>Melanoides aculeus</i> (Lea)	(Grateloup)
" <i>crenulata</i>	<i>Faunus nitidus</i> von der Busch
(Deshayes)	<i>Potamides fluviatilis</i> (Potiez
" <i>hastula</i> (Lea)	and Michaud)
" <i>lateritia</i> (Lea)	

<i>Melanoides rhizophorarum</i> (A. Adams)	<i>Potamides sulcatus</i> (Born)
	“ <i>palustris</i> (Linnaeus)

Lilimbon River, near source, Marivelles, Luzon

<i>Brotia asperata</i>	<i>Neritina brevispina</i> (Lamarck)
(Lamarck)	“ <i>diadema</i> (Recluz)
<i>Melanoides aculeus</i> (Lea)	“ <i>pulligera</i> (Linnaeus)
“ <i>crenulata</i>	<i>Navicella cumingiana</i> (Recluz)
(Deshayes)	
“ <i>hastula</i> (Lea)	
“ <i>lateritia</i> (Lea)	

Lilimbou River, 20-25 ki. from source

<i>Melania setosa</i> Swainson	<i>Melanoides pugilis</i> (Hinds)
<i>Melanoides aculeus</i> (Lea)	<i>Neritina brevispina</i> (Lamarck)
“ <i>crenulata</i>	“ <i>diadema</i> Recluz
(Deshayes)	“ <i>pulligera</i> Linnaeus
“ <i>hastula</i> (Lea)	<i>Navicella cumingiana</i> (Recluz)
“ <i>lateritia</i> (Lea)	

Lilimbon River, near mouth

<i>Melania setosa</i> Swainson	<i>Melanoides pugilis</i> (Hinds)
<i>Melanoides aculeus</i> (Lea)	<i>Neritina diadema</i> Recluz
“ <i>crenulata</i>	“ <i>pulligera</i> Linnaeus
(Deshayes)	<i>Navicella cumingiana</i> (Recluz)
“ <i>hastula</i> (Lea)	
“ <i>lateritia</i> (Lea)	

Antipode River, tributary of Pasig River, Luzon

Brotia asperata (Lamarck) *Pila scutala* (Mousson)

TRANSPOSED HINGE TEETH OF NORTH AMERICAN NAIADES

BY HENRY VAN DER SCHALIE

In connection with my work of the past few years, which was concerned largely with studies of our American freshwater mussels, I observed a number of variations in the tooth-structure of the hinge. I had accumulated quite a series of such variations when I noted a paper on the subject by Popenoe and Findlay. These men in their paper on "Transposed Hinge Structures in Lamellibranchs" have not only accumulated an interesting series